Description

ELECTROMOTIVE DRIVE

[0001] The invention relates to an electromotive drive, with at least one fan wheel which can be driven by an electric motor, an electromagnetic slip coupling, dependent on the motor speed, being arranged between the motor shaft and the freely rotatably mounted fan wheel.

[0002] Electric motors for rail and rail-bound vehicles, such as three-phase traction motors, are increasingly being operated at high speeds, in order to keep down the motor torques and consequently the motor weight and also the size. According to EP 0 826 266 B1, a fan wheel mounted freely rotatably on the motor shaft is provided for motor cooling, an electromagnetic speed limiting and governing device which limits the delivery of cooling air to the required quantity of cooling air being formed between the motor shaft and the fan wheel, and it being possible as from a predeterminable motor speed for the fan wheel speed to be reduced in relation to the motor speed in such a way that the driving-along effect of the slip coupling can be neutralized with increasing speed of the motor shaft until it is almost ineffective and increases again to the full driving-along effect as the motor speed drops.

[0003] In the earlier German patent application 198 01 310.8, an

electromotive drive of this type is described, the slip coupling being designed in such a way that the motor shaft bears permanent magnets and segments are cut out in the hub of the fan wheel, or that the fan wheel is provided with permanent magnets and the motor shaft has segmental cutouts over its circumference in such a way that, in the interaction of the segmented fan wheel hub with the permanent magnets of the motor shaft, or in the interaction of the segmented motor shaft with the permanent magnets of the fan wheel, and dependent on the motor speed, the speed limiting and governing device is effective. This slip coupling operates on the reluctance principle.

[0004] The object of the invention is to improve further an electromagnetic drive of the type described with respect to its self-ventilation or motor cooling by at least one fan wheel which can be driven by the motor.

[0005] This object is achieved according to the invention by the features of patent claim 1. This achieves the effect that the quantity of cooling air at relatively low motor speeds is available to an adequate extent, while the quantity of cooling air to be delivered at relatively high or high motor speeds no longer increases in proportion to the increasing motor speed. The fact that, according to the invention, the fan wheel is mounted in the motor casing or on the bearing plate, and consequently not on the motor shaft, always results in an adequately high fan-wheel bearing speed, even when the relative speed of the motor shaft to the fan wheel is small or approaches zero. As a result, better running behavior

and improved bearing lubrication of the fan wheel mounting are achieved. Whereas in the case of the known mounting of the fan wheel on the motor shaft the lubricant is forced by the then rotating bearing outer race and the centrifugal force toward the outer race and leads to increased bearing friction, the bearing outer race of the mounting of the fan wheel arranged in the motor housing or in the motor bearing plate is stationary, which reduces the bearing friction. The mechanical isolation of the fan wheel from the rotor of the electric motor has the effect of reducing for example bearing loads caused by a rotor imbalance.

[0006] According to one configuration of the invention, it is provided that the electrically conducting part of the fan wheel or of the motor shaft forming the electromagnetic slip coupling with the permanent magnets of the motor shaft or of the fan wheel comprises a sleeve of electrically conductive material. This has the effect that the electrically conductive sleeve, which is to be of a simple design and is seated in the magnetically permeable fan wheel hub, dispenses with the need for an additional cage winding. The simple to produce sleeve preferably consists of copper.

[0007] According to a further configuration, the fan wheel or the fan wheel hub may consist of nonmagnetic material, for example aluminum, dispensing with an additional sleeve. On the other hand, the fan wheel may be made of plastic, with an electrically conductive sleeve, for example a copper sleeve, fitted into the plastic hub. In the case of these configurations, a weight reduction is possible,

which is important for drives operating at high speeds.

[0008] A further configuration is distinguished according to the invention by the fact that, for a drive with a small overall axial length, the parts of the electromagnetic slip coupling (magnets and cage) are not arranged coaxially, but radially (disk rotor principle) in relation to the motor shaft.

[0009] According to the invention, the electromagnetic slip coupling may be designed such that the center of the magnets and of the cage are axially offset, producing an axial force component which acts on the fan wheel mounting and prevents a tumbling movement. In this case a fan wheel mounting can only be configured with one bearing, for example a double-row bearing or a mounting unit, between the motor casing or the motor bearing plate and the fan wheel.

[0010] The invention also comprises a configuration as claimed in claim 8, the electromagnetic slip coupling of which operates on the reluctance principle, it being possible for the slip coupling parts also to be configured without the cage winding or copper sleeve.

[0011] In the design of the electromagnetic part of the slip coupling, pairs of permanent magnets may also be replaced by one or more bar magnets, which are able to be fitted for example into transverse bores of the motor shaft or in bores of the fan wheel. In this case, resultant centrifugal forces on the magnets

can be avoided and simple fastening and fixing of the bar magnets is possible.

[0012] Advantageous configurations of the invention are specified in the further patent claims.

[0013] The invention is explained below on the basis of an exemplary embodiment with reference to the drawing, which shows a partial section through an electromotive drive according to the invention, as is suitable in particular for three-phase traction motors capable of being operated at high speeds.

[0014] Of an electric motor 1 known per se, a motor bearing plate and a motor casing cover 15 of the motor casing 5 are shown, as well as a motor shaft 3, a motor shaft bearing 13, a motor shaft bearing cover 14 and also a fan wheel 2 with a fan wheel blade 16. According to the exemplary embodiment depicted, the fan wheel 2 is mounted freely rotatably by means of its fan wheel hub 7 in coaxial arrangement in relation to the motor shaft 3 in the motor casing 5 or in the motor bearing plate. The mounting of the fan wheel 2, comprising two bearings 4, 4' in the configuration represented, is seated with its stationary bearing outer race in a bearing receptacle 8 of the motor casing 5 or of the motor bearing plate, with an annular formation 9 on the fan wheel hub 7 being supported against the rotating bearing inner race of the fan wheel bearing 4, 4'. As represented, the mounting of the fan wheel may comprise, for example, two bearings 4, 4' or a double-row bearing or else a mounting unit with the bearing

rows 4, 4'. The mounting is also assigned an axial fixing means known per se (not represented).

[0015] Between the freely rotatably mounted fan wheel 2 and the motor shaft 3 there is an electromagnetic speed limiting and governing device for the cooling air blower. The device designed as an electromagnetic slip coupling acts in such a way that, with increasing motor speed, in particular as from a specific speed range, the drive effect on the fan wheel via the slip coupling decreases. On the other hand, with a motor speed dropping below a specific speed range, the slip coupling causes the drive effect of the coupling on the fan wheel to increase again. The parts 6, 10 of the electromagnetic slip coupling separated by a predeterminable air gap 11 are formed by magnets 6 or a cage 10.

[0016] In the exemplary embodiment depicted, the motor shaft 3 bears permanent magnets 6, whereas the fan wheel 2 or the fan wheel hub 7 is fitted with one or more squirrel-cage or cage windings 10. The cage 10 is made from a copper sleeve, which can be fitted into the hub 7 of, for example, a plastic fan wheel 2. An air gap between the bearing formation 9 on the fan wheel hub and the motor shaft 3 is denoted by 12.

[0017] According to an exemplary embodiment not represented, the permanent magnets may also be arranged on the fan wheel and the electrical part 10 of the cage may be arranged on the motor shaft. The magnetic excitation

of the slip coupling takes place via the permanent magnets and on the basis of the rotation of the motor shaft 3 or of the fan wheel 2. The torque required for driving along the fan wheel is produced by induction of an electric voltage in the cage 10 in the same manner in principle as in the case of an asynchronous machine with a cage rotor. The arrangement is dimensioned in particular such that - disregarding possible reaction torques - the maximum torque (breakdown torque) is reached at a predetermined speed, at which it is sufficient to overcome the drop in pressure of the aerodynamic circuit. This speed will generally lie between 50 and 75% of the highest motor speed. If the motor speed increases above this value, a lower speed is established on the basis of the torque-slip characteristic of the coupling for the fan wheel, whereby the quantity of cooling air, energy consumption and noise of the fan are reduced.